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EXTRACT FROM OPERATING MANUAL (OM-40) SECTION 1400 CONDITIONING BUILDING 216 DISPOSAL TOWER VOLUME XXIII PART III

Compiled by
S. G. Thornton
Environmental Management Division
OAK RIDGE K-25 SITE
for the Health Studies Agreement

October 2, 1995

Oak Ridge K-25 Site
Oak Ridge, Tennessee 37831-7314
managed by
LOCKHEED MARTIN ENERGY SYSTEMS, INC.
for the U.S. DEPARTMENT OF ENERGY
under Contract DE-AC05-84OR21400

OPERATING MANUAL

SECTION 1400
CONDITIONING BUILDING
216 DISPOSAL TOWER

VOLUME XXIII

-2- PART III ON-40

UNCLASSIFIED A-3470

SECRET

OM 40

(A-3470)

This document consists of 16 pages, No. 1 of 3 copies, Series A and 36 Figures, No. I-1 through III-5.

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Gary W. Hall, AR
& David A. Gilliland, ADD

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SECTION 1400

CONDITIONING BUILDING

216 DISPOSAL TOWER

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VOLUME XXIII

PART III

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1. FUNCTION AND BRIEF DESCRIPTION

(a) Function

The 216 disposal tower in Building K-1405 is used to convert 216 and OA to harmless materials before venting gases containing these substances to the atmosphere. Gases disposed of in this tower include excess 216 generated in Section 1300 and 216 and OA present in equipment of Sections 100, 130, 300, 400, 500 and 630 and 1400 after conditioning with 216.

(b) Brief Description

The method used to dispose of the 216 and HF is as follows:

The 216 and HF are absorbed in a solution of caustic soda and the resulting sodium salt of 216 is reacted with calcium hydroxide. This forms the insoluble and relatively non-poisonous calcium salt of 216 and at the same time, regenerates the caustic soda which is then used over again. The calcium salt is eventually pumped into a holding pond where it mixes with the insoluble calcium sulphate and chromate salts from the acid neutralization plant. The holding pond is large enough to hold several years production of calcium salts.

Traces of 616 which may be present in gases treated in Building K-1405 are also absorbed. Most of the 616 is precipitated as sodium uranate in the disposal tower, but a small fraction of the 616 may remain in solution as a peroxide as long as 216 is being absorbed.

Development work on a modified process for absorption of 216, OA, and 616 is now underway. If successful, this process will have the advantage of keeping the 616 in solution and preventing the deposition of sodium uranate in the disposal tower. If this process is developed to the point where it can be recommended in preference to the one described in this manual, a supplementary manual will be issued.

soda lime

OUTLINE OF LIQUID FLOW

As shown on the simplified flow diagram Figure I.1-1, the 216 gas enters the carbon-lined and packed absorption tower through three monel nozzles at the bottom. Caustic soda solution enters the top of the tower through a single fluid distributor and flows downward, absorbing 216 and OA and forming the sodium salt. The essentially pure 74 leaves the tower through the stack at the top. The sodium salt solution is removed from the base of the tower by one of two centrifugal pumps and pumped to the reaction tank where it is mixed with lime slurry. The resulting calcium salt suspended in a caustic solution is drained into the settling tank where it settles and the supernatant caustic solution flows over a weir to be pumped by the tower feed pumps to the top of the tower. On the way it

calcium hydroxide

passes through either a preheater or a cooler to be heated or cooled depending on the operating conditions. After several months of continuous operation, as much as possible of the supernatant NaOH in the settling tank is pumped through swing pipes to the caustic decantation tank. The precipitated calcium salt of 216 is slurried up and pumped by the slurry pump to the acid neutralization building. During this operation, which should be done at a period of minimum conditioning activity, the 216 is by-passed up the emergency stack.

The lime is slaked in one tank and then pumped into the reaction tank by one of the two slurry pumps. The slaking liquid is caustic soda which is recycled from the tower entrance and cooled in a cooler.

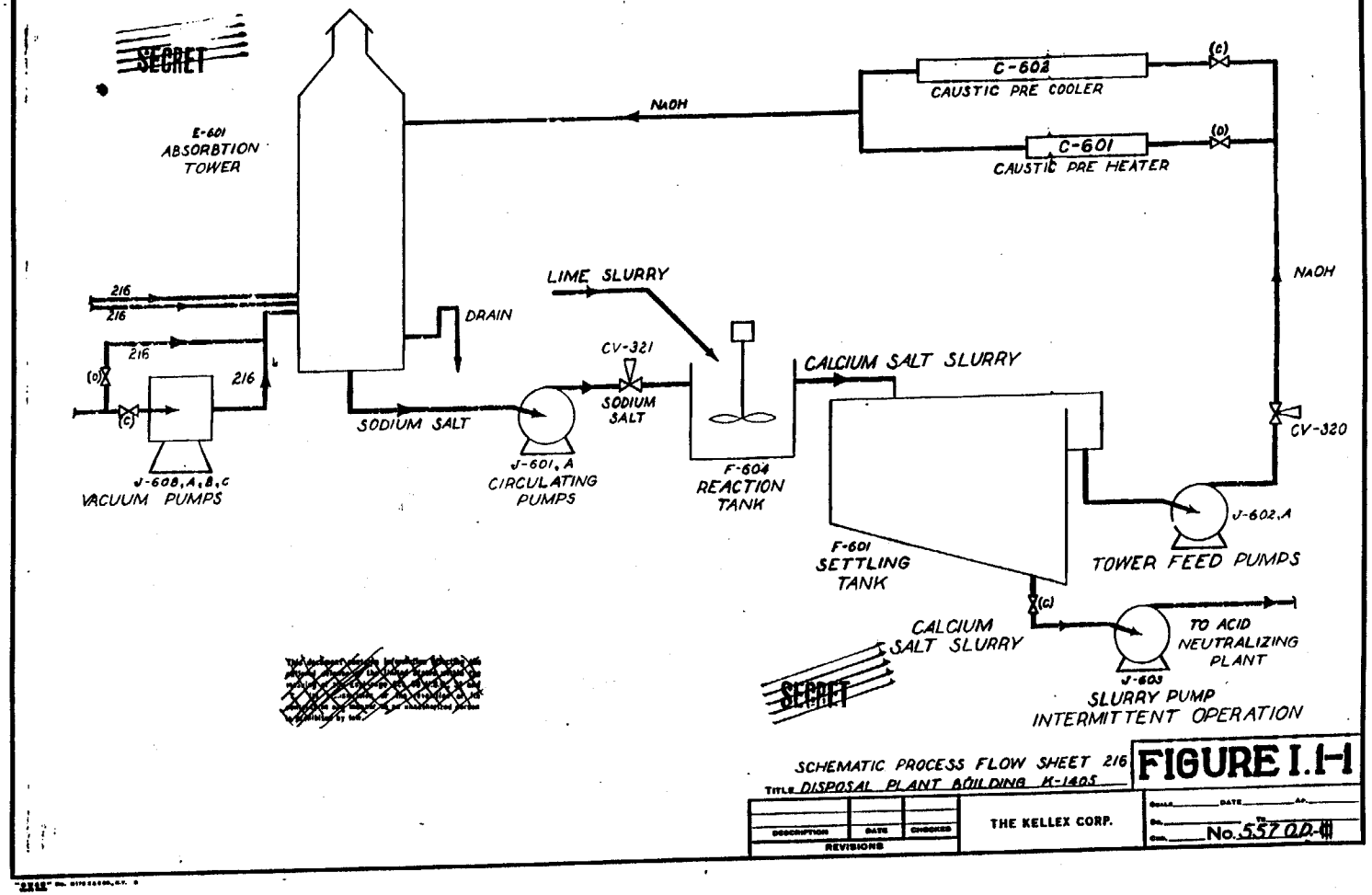
Caustic solution is delivered in tank cars at 50% concentration and pumped by the caustic feed pump into the storage tank where it is diluted to about 25%. It may be pumped into the settling tank by either the caustic feed pump or the slurry pump, as needed.

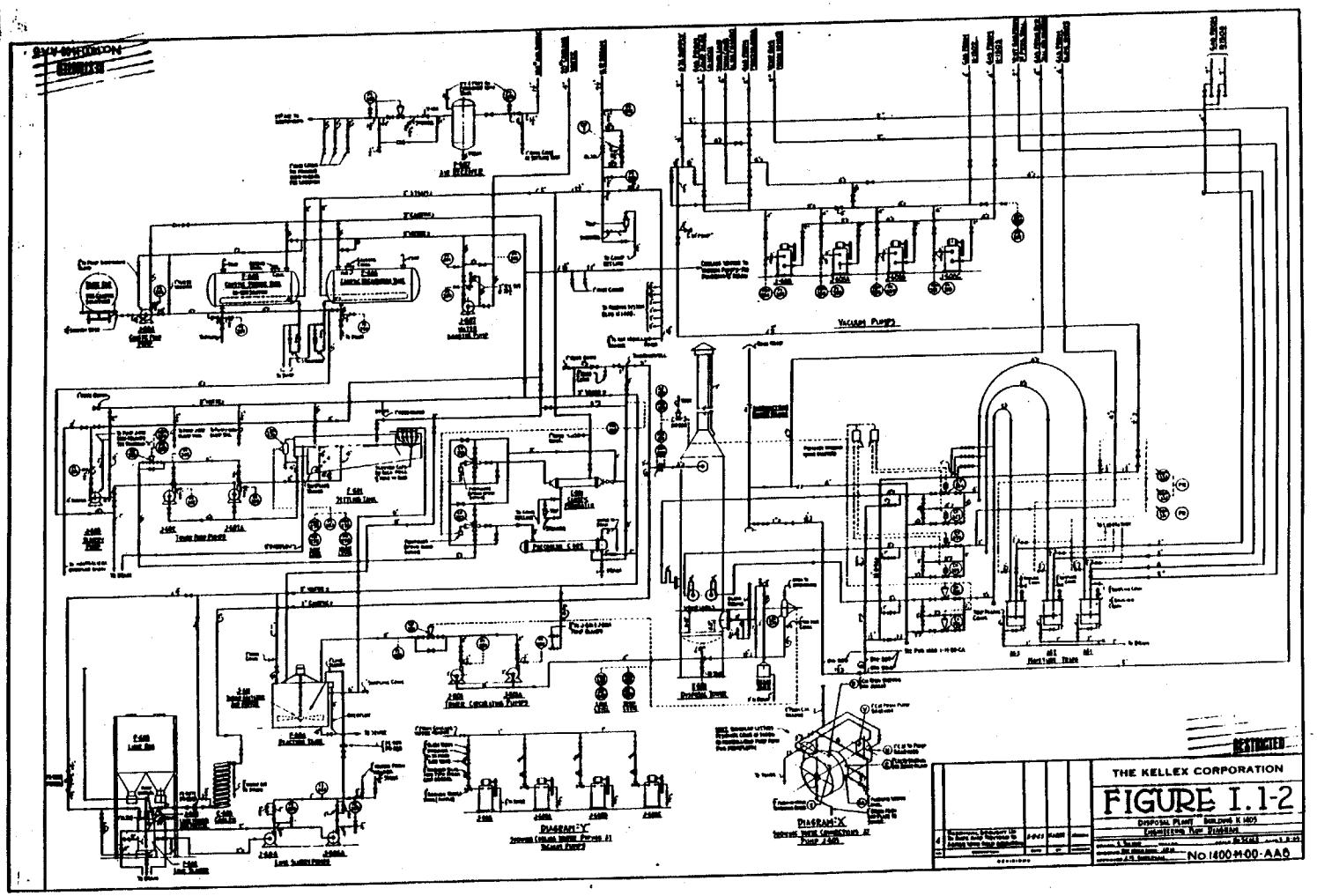
The 216 can enter the tower under its own pressure or it can be pumped by the 100 cfm Stokes vacuum pumps.

The lime slurry pumps and the tower feed and circulating pumps which are in continuous use are all provided with spares. The slurry pump is used intermittently but can be used to replace the caustic feed pump. The caustic feed pump is piped so that it may serve all the functions of the slurry pump but it is not recommended that it be used to pump the calcium salt slurry mixture. There is no spare for the water booster pump. Four Stokes pumps are provided, so that there are plenty of spares.

A more detailed engineering flow diagram is given in Figure I.1-2.

[redacted]


SECRET
E-601
ABSORBTION
TOWER
NaOH
C-602
CAUSTIC PRE COOLER
C-601
CAUSTIC PRE HEATER
(c)
(o)
LIME SLURRY
NaOH
216
216
216
216
DRAIN
CV-321
SODIUM
SALT
CALCIUM SALT SLURRY
CV-320
SODIUM SALT
J-601, A
CIRCULATING
PUMPS
F-604
REACTION
TANK
J-608, A, B, C
VACUUM PUMPS
F-601
SETTLING
TANK
J-602, A
TOWER FEED PUMPS
CALCIUM
SALT SLURRY
TO ACID
NEUTRALIZING
PLANT
J-603
SLURRY PUMP
INTERMITTENT OPERATION
SECRET
SCHEMATIC PROCESS FLOW SHEET 216
Title DISPOSAL PLANT BUILDING K-1405
FIGURE I.1-1
DESCRIPTION
DATE
CHECKED
REVISIONS
THE KELLEX CORP.
No. 557 00-III


RESTRICTED
Vacuum Pumps
DIAGRAM 'X'
DIAGRAM 'X'
RESTRICTED
THE KELLEX CORPORATION
FIGURE I.1-2
No 1400-M-00-AA6

II. ENGINEERING DESCRIPTION

(a) Building

Equipment for the disposal of 216 is housed in Building K-1405 located in the northeast section of the K-25 area. The equipment location plan for this building is shown on Figure II.1-1, while sections and elevations are shown on Figure II.1-2. Outside of the building to the southeast are two large caustic storage tanks F-605 and F-606, located alongside the railroad siding.

EAST WING

The east wing is a single room 33'-4" by 32'-8" by 20'-0" high and is separated from the remainder of the building by an 8" thick tile wall. This wing houses the large settling tank F-601, the two tower feed pumps J-602 and J-602A which pump the supernatent liquid from the tank to the top of the disposal tower, the slurry pump J-603 which pumps precipitated material out of the tank, tower feed preheater C-601, tower feed precooler C-602 and cooling coil C-603. A stairway from this room leads upstairs to the second floor of the middle section of this building.

MAIN WING

The main wing of Building K-1405 is 16'-0" x 48'-8" x 20'-0" high and is built in two stories with the second floor level being 12'-0" above the ground floor level. The ground floor of this wing houses the water booster pump J-607, the caustic recirculating pumps J-601 and J-601A, the lime slaker F-602, the lime slurry pump J-606, and the air receiver F-607. The lime storage bin is also located on this floor, however, it extends up through the second floor a height of 3'-1". The south end of this section is used to store lime bags. A trolley hoist is provided directly above this area 18'-6" above the ground floor level to lift the sacks of lime to the second floor. The upper floor is a combination laboratory, control room and office. The reaction tank F-604 and the lime hopper on F-603 are also located on this floor south of the office.

WEST WING

The west wing of the building is a small one-story shed housing the stokes vacuum pumps J-608, 608A, 608B, and 608C which are used to pump 216 from the process and conditioning areas.

DISPOSAL TOWER

The disposal tower is just outside the main wing of the building, to the north.

(b) 216 System, Vacuum Pumps and Tower

The 216 piping in and around the pump room is shown in isometric on Figure II.1-3 and in plan and sections on Figure II.1-4. The following description and drawings are in accordance with changes agreed to be Carbide and Carbon but may not yet have been made at the time of this writing.

216 enters the K-1405 building at the southwest corner through four monel pipes. Two six inch lines G-301A and G-308 come from the conditioning building; the former line is 7'-0" above the ground and is the regular line while the latter one, 13'-[illegible]" above

the ground is a spare. The third, G-301C, is a six inch header from the process area. These three join to from G-306 and are valved as shown in Figure II.1-4. The fourth, G-315A is a 2" vent pipe from K-1301. It goes directly through the vacuum pump room to a separate nozzle in the absorption tower.

Line G-306, formed from the three six inch lines feeds the first two Stokes pumps. It then reduces to four inches, marked G-305, and supplies the remaining two pumps. A valve divides the two pipes. The northern end of G-305 is valved and turns west, passing to the wall. At this point it joins G-302-B, a four inch pipe which goes directly to the tower. G-302-A is a four inch by-pass which connects G-302-B with the valving at the junction of the three main incoming lines. It is joined to G-306 between the first and second pumps through a four inch valved pipe. It is similarly connected to G-305 between the second and third pumps.

Each one of the four inch pump suction pipes is valved. The two inch valved discharge pipes, G-310 pass directly up to form the discharge header G-307, which is four inches in diameter over the three northern pumps and two inches over the first one. Upstream of the valve, G-310 gives use to a two inch pipe which passes east to the two parallel connected mist filters. Each pump is provided with two individual filters. Both are used simultaneously and are valved at the inlet and outlet. The one and one-half inch outlet pipes from a filter pair empty into G-307 as shown.

Precovered oil from the mist filters drains back into the pumps as illustrated.

The four inch pipe from K-1302 enters through the north wall of the pump room and is valved into G-305 between the third and fourth pump.

The piping at the tower is shown in isometric in Figure II.1-5 and in plan and sections in Figure II.1-6.

The four inch tower feed line which is marked G-302-B in the pump room is G-317 outside. It passes directly north to a point 12 feet from the building wall and turns east for 10-1/2 feet, joining the emergency stack pipe. In this stretch it is joined by a four inch rupture disc vent line from Section 1300 and gives off a four inch pipe to the electrically operated control valve nest and a four inch pipe, provided with a locked-closed valve, to the northern tower nozzle feed line. A liquid pressure seal by-passes the vent line to the emergency stack, as shown. It also receives a 2" cross-connection from the other tower nozzle inlet system.

From the control valves a four inch pipe runs south to moisture trap AG-1. The trap outlet loops over and is then valved into the north nozzle.

Three two inch lines from Section 1300 come in from the north and are valved together. The two inch pipe thus formed travels east and

enters the emergency stack pipe through a valve. It gives off a two inch line which runs south to meet the two inch line from K-1301 which comes out of the vacuum pump room. This pipe is provided with a valve, north of which is the cross-connection to G-317, and south of which is the air operated control valve nest inlet. A two inch pipe from these valves enters AG-2, the outlet of which loops over and enters the northwestern nozzle. The third nozzle is blanked off.

Lines from both control valve nests enter the emergency stack pipe as shown. A four inch by-pass is provided which connects the incoming line from Section 300 directly with the emergency stack pipe.

Heaters are provided on the gas inlet nozzles to prevent condensation of back-diffusing water and thus minimize corrosion. Also, N_2 is admitted from rotometers to the outlet lines of the moisture trap. This serves to sweep back-diffusing water out of the inlet lines.

There are three nozzles on the tower, two of which are used and are supplied by its own loop and moisture trap. The largest one, four inches in size, is on the north side of the tower and is connected to AG-1. The other two are on the west side. The three inch one is supplied by AG-2. It is used only during emergencies in K-1301, K-1302 and K-1303 and was provided especially for this purpose at the request of the Hooker Electrochemical Co. The third nozzle is blanked off.

The emergency stack is located on the brow of the hill overlooking the holding pond, about eighty feet north of the tower.

It is used only when the disposal tower is not operating.

(c) Caustic and Lime System

All caustic and lime piping in the system is made of steel. Sections are either welded together or connected by rubber gasketed flanges. Figures II.1-7 and II.1-8 illustrate the caustic and lime piping arrangement. Sodium hydroxide enters the building from the bottom of the decantation tanks F-605 and F-606 through a 4" underground pipe near the southeast corner of the building. This pipe goes to the suction of pump, J-603. Joining this pipe at the pump suction is a 6" pipe which enters the settling tank through a worm geared valve at the bottom and through two 4" adjustable overflow pipes in the two east corners of the tank. The 4" pipes are used for decanting clear NaOH from the top of the tank, after which the solids are removed through the 6" pipe in the tank floor.

The discharge from the J-603 pump has two branches. One goes thru the east wall of the building and runs underground to the acid neutralizing pit. The other is further branched near the roof, with one pipe going to the tower and to both the reaction and settling tanks, and the other going to the tops of the two caustic tanks, there joining the discharge pipe from the 604 feed pump.

The overflow from the weirs at the east end of the settling tank is carried by a 4" pipe to the inlets of pumps, J-602 and J-602A. A 3" pipe from the pump outlets goes through a control valve placed at the east end of the settling tank to the two 3 way control valves which adjust the flow through heater C-601 and cooler C-602. These are connected in parallel and are both located above the north end of the settling tank. Their common 3" outlet goes out the north wall of the building near the roof and bends upward to enter the top of the disposal tower on the east side. A 3" pipe connects this line with the pipe from the discharge of J-603, as illustrated.

A 1" caustic recycle line is taken off the tower feed pipe near the coolar. This goes to the 603 cooler which is located between the west side of the settling tank and the wall in the north corner just under the tank grating. From this cooler a 1" pipe goes through the wall and runs south to the lime slaker, which it enters through a float controlled valve.

Spent liquor is removed from the bottom of the tower through a 4" pipe which enters the building through the north wall, branches, and goes directly to the suction flanges of circulating pumps, J-601 and J-601A. The 3" discharge pipe from these pumps runs south to the north side of the reaction tank and then goes up through the floor to a control valve, from which it enters the reaction tank through the top.

Calcium fluoride slurry leaves the reaction tank through a 6" pipe in the east side near the top. This pipe runs east through the wall. On the other side it joins the 6" tank feed pipe running north and south over the west end of the settling tank which has 3 short 3" pipes extending down from it into the tank. These pipes are capped and have 1-1/2" holes drilled through the caps.

The lime slurry from the slaker runs south in a 1-1/2" pipe to the suction flanges of slurry pumps, J-606 and J-606A. The discharge runs north overhead under the reaction tank. It goes up through the floor on the north side of the tank and enters it through the top near the spent liquor entrance.

(d) Process Water Piping

The water used in the disposal process enters the building through the south wall of the line storage compartment from an underground pipe, as illustrated in Figure II.1-9. A 4" pipe runs overhead on the west side of the lime room to the water booster pump, J-607 located between the slaker and the tower circulating pumps near the wall of the vacuum pump room. The water booster pump discharges into a closed loop of 3" pipe which runs completely around the settling tank and lime slaking rooms at an average height of about 12 feet. A relief valve, set at 75 lbs, is installed in the pump discharge to release excess water pressure into the water supply line.

At appropriate places along the loop smaller pipes are tapped off to supply water to the smothering glands and cooling jackets of the various pumps. A 2" pipe on the north side supplies the 602 precooler while a 1-1/2" line goes to the C-603 cooler. On the south side, a 3" pipe 12 feet above the floor runs directly into the wall of the settling tank.

From the south east corner of the settling tank room a 3" pipe runs over to the inlet flanges on top of the caustic tanks. From this pipe a 1/4" branch goes to the pump smothering gland of J-604 while a 1" line tees into the suction pipe of J-604 to supply water for flushing purposes.

From a tee in the southwest corner of the settling tank room a 1-1/2" pipe runs north along the west wall 3 feet above the top of the tank. This pipe supplies water to the reaction tank and joins the 3" caustic pipe from the cooler and heater to furnish water for flushing the tower.

On the west side of the loop, connections are made to the lime slaker and the vacuum pump cooling jackets. Various hose connections are provided, so that all parts of the floor may be washed frequently. Waste water from all sources is drained into the sewage system.

(e) 74 System

74 is used in the K-1405 building to purge certain lines of 216. The two inch supply header runs under the eaves of the west side of the building, as shown in Figure II.1-10. At the south end of the vacuum pump room a 1-1/2" pipe from the main header supplies 74 to the conditioning building and process area 216 lines through 2 double-valved connections. The supply header continues north and enters the base of the emergency exhaust stack. Opposite the control valve nest at the base of the disposal tower a 1-1/2" line from the main header runs east and then south. Near the tower nozzles it is reduced to 1/2" and continues on through the east side of the vacuum pump room, and joins the 1-1/2" pipe at the south end, thereby forming a complete loop. Near the tower five connections are made from the 1-1/2" pipe to the 216 lines. All five are valved with sets of "SM" and "SS" type valves. Two of the connections are made to the inlet side of the moisture traps. Two more purge the two tower nozzles while the fifth purges the base of the emergency stack pipe. A sixth connection, not illustrated in Figure II.1-10, purges the three two inch lines from Section 1300 in the northern section of the yard. Connections are made to the buffer zones of DBM-331, and 333 and PBM-334, 335, 336 and 337, as indicated on Figure II.1-10.

The valves on the 216 and 74 lines are special Kellex G-17A, SM and SS units. The Operating Manuals, Volume X, "Special Valves" and "Special Valve Addendum" should be consulted for information regarding their operation and maintenance.

(f) Electrical System

Three phase, 440 volt electric power is supplied to Building K-1405 for operation of the various motors and for lighting. From manhole 14E, 250 feet to the west of the building, 300,000 CM feeders in a 4" underground conduit enter the west side of the lime storage room and go to a 600 volt, 600 ampere air circuit breaker mounted on the west wall. #00 cables from the breaker connect to two adjacent 200 ampere, 575 volt unfused disconnect switches, one each for Buildings K-1407 and K-1405. The conduit from the K-1405 switch crosses the room near the ceiling to supply the wire trough under the contactors on the east wall of the lime slaking room. As shown in Figure II.1-11, all the motor contactors are mounted along this wall. Conduits connect the contactors with the push button stations located near their respective motors, as shown in the same figure.

Two-25KVA 480/208/120V transformers are located under the stairs in the lime storage room. The northernmost one reduces the incoming voltage to 120 volts. The resulting three phase, 4 wire system supplies power to the lighting and utility panel on the east wall opposite the lime slaker.

The other transformer supplies 208 volt power to the base and body heaters of the four Stokes pumps. It also supplies a wall receptacle near the lime slaker. This is intended for a portable mixer for the slaker.

Three underground conduits run east around the caustic tanks as shown in Figure II.1-11. Two are used in the operation of J-604. The other supplies power to K-1407 from the 200 ampere switch mentioned above.

Figure II.1-11 shows the conduits for two J-612 blowers. This equipment is no longer in use in Building K-1405 and has been removed. The wiring diagram for the building equipment is shown in Figure II.1-12.

(g) Steam Piping

Steam is used in Building K-1405 for heating and blowdown purposes. The steam enters the building at a minimum pressure of 100 psig and a maximum pressure of 175 psig. The supply pipe is taken from the steam plant's north main line to the process area. A 2-1/2" pipe travles south and enters the north side of the disposal building about seven feet above the ground, just to the east of the absorption tower. A pressure reducing station, located under the stairs to the office, reduces the pressure to 20 psig. From the reducing station, a 2-1/2" pipe runs up above the preheater on the settling tank and divides. One branch supplies the preheater and

continues around the east side of the building to the two caustic tanks outside. Refer to Figure II.1-13 for details. The other branch travels west to the wall of the slaker room and then south to the lime slaker. Five connections are made from this line to the building heating and hot water systems. A one inch hose connection is provided above the settling tank near the east end of the precooler.

Condensate is collected as shown in Figure II.1-14 and returned to condensate collecting station "C" near Building K-1408. The 2" return line runs underground, leaving the building at the northwest corner. Condensate from the caustic tanks is piped into the sewage system.

(h) Air System

Instrument air at 100 lbs pressure enters the building from the north side eight feet above the floor over the westernmost tower circulating pump. The 1-1/2" pipe travels south along the west wall of the room to the air receiver F-607 near the lime slaker. A connection is made to the air reciever and a 1" pipe continues south, turns east and enters the settling tank room where a hose connection is installed. This enables the solids in the settling tank to be slurred up with high pressure air. Figure II.1-13 shows the air system for this operation.

Air from F-607 is filtered and reduced to 35 lbs pressure by a Y type strainer and a pressure reducing valve and fed into a loop of 1-1/2" pipe, which encircles the settling tank, extending to the west wall of the lime slaker room. The loop has 3-1" hose connections. Two are in the slaker room, opposite the corners of the settling tank while the other is opposite the center of the east wall of the tank. A 1/2" pipe supplies the lime slaker from the west side of the loop. Several air take-offs supply the instruments, which are located at various points in the building.

(i) Heating and Ventilation

Six steam heaters provided with electric fans and three radiators are used to heat the building during the cold season, as shown in Figure II.1-14. The electric fans receive power from the 120 volt lighting system. The heater at the south end of the vacuum pump room is designed to take at least 25% of its suction from the outside atmosphere to protect the operators in this room.

Three gravity ventilators are provided. There is one each over the settling and reaction tanks and one for the vacuum pump room. In addition, the vacuum pump room is equipped with a one-half horse-

power exhaust fan. This takes suction through two ducts with inlets at floor level, as 216 is heavier than air. The discharge from the fan goes through the roof to the outside. Ordinarily the fan will operate only when the 216 concentration is noticeable. The push-button station for this fan is located outside of the building, just south of the north door of the vacuum pump room.

(j) Instrumentation

Figure I.1-2, the engineering flow diagram shows all the plant instruments and consequently, serves as an instrument application diagram. Only a small number of the indicating instruments are located on the panel in the control room. The great majority of them are locally mounted.

Figure II.1-15 shows the rear of the control room instrument panel. PI-402 indicates the yard 74 pressure. PI-359, 319, 315 and 410 indicate respectively, the building steam pressure, the building air pressure, the water main pressure, and the building water pressure. PI-353 indicates the settling tank overflow level, in conjunction with LRM-273. HBM-354 is a loading station for CV-320 on the discharge of the tower feed pumps. PI-355 shows this pressure, which is a function of the flow to the tower. XX-356 is a vent for the four 216 tower by-pass valves. Opening the vent will change the valve positions so that 216 will pass through the emergency stacks.

TRC-275 is the temperature controller for the tower feed. FRC-281 records the flow of caustic to the tower. It operates PBS-350 which sounds the alarm when the flow is too low. The four tower by-pass lines are operated by FRC-281. Two of them are electrically operated and require pressure switch intermediaries.

AI-357, 349, 407, 279 and 277 are red indicating lights. They light on signal from their respective pressure switches. Whenever one of the lights goes on horn AI-348 will sound. The horn may be silenced by momentaily pressing the button under the illuminated light. The light, however, will remain on until the pressure switch drops below its set point.

Two switches for the two electrically operated motor valves are mounted on the center of the panel. These are manual reset switches. Pressing these switches will return the valves to their normal positions. The air operated valves are reset automatically by the controller output pressure.

DBM-333, and 331 together with PR-294, and 296 record the tower nozzle pressures downstream of the moisture traps. These are the only indicators of nozzle plugging. The low side of the DBM's are open to atmosphere, hence gauge pressure is recorded.

The five DBM's and indicators which measure the suction and discharge pressures of the Stokes pumps, are located in the pump room.

V. EMERGENCIES

(a) Failure of Caustic Flow

If the caustic flow to the tower should fail, the automatic by-pass valves will divert the 216 to the emergency stack. It is considered undesirable to have 216 flow through the dry tower as considerable heat may be evolved which might injure the tower internals and might even ignite the lining. In addition, so much sodium fluoride may be formed that the tower will plug. PBS-350 should illuminate AI-357 when the caustic flow rate drops to the danger point. The setting for this switch will have to be determined in the field. This will give the operator time to start the spare J-602 pump if the pump and power for it are available. If the spare pump is not started and the flow of caustic drops further the control valves will operate. If the control valves fail the operator should flood the tower with water through the 2 inch plug cock shown in Figure II.1-9. Then the drain valve in the bottom of the tower should be open to allow the water to flow into the sewer. The 216 should be manually diverted to the emergency stack and the plant closed down, as described previously.

(b) Tower Plugging

If the tower shows signs of plugging, which will be manifested by a drop in the rate of both input and output pumping speeds necessary to keep the bottom liquid level constant, the following steps should be taken in the order mentioned. This plugging will probably be due to the formation of sodium fluoride.

(1) Analyze the tower feed and effluent first for fluoride ion, and then for solid fluoride salts, solid calcium oxide, and sodium hydroxide as may be indicated. Check the tower flow rates; if both the tower input and output have fluoride ion concentrations about 7,500 ppm, it is probable that sodium fluoride is precipitating in the tower. This may be corrected by increasing the rate of lime feed. If the caustic concentration is high, above 10%, reduce it since a high sodium hydroxide concentration will reduce the solubility of both lime and sodium fluoride. If the difference between input and output fluoride concentrations is large, of the order of several hundred ppm with an output concentration of 1500 ppm, if the disposal load is heavy and if the downflow is small, it is probable that there is not enough caustic. To correct this increase the downflow.

If the solid concentration in the tower feed is greater than the concentration in the effluent, it is probable that the tower is being plugged by the difference. In this case the settling tank is too full and does not allow sufficient settling time. If it is determined from the analysis that solid lime is causing the plugging and the settling tank is fairly empty, the lime particles may be too small to settle in the tank and are carried

to the tower. The lime particles may be smaller to begin with or the turbo mixer may be breaking them into smaller bits. The mixer may be operated at a lower speed or the stator may be removed to minimize the shearing action. If the analysis show that solid fluoride is causing the trouble, ferric sulfate may be added as a coagulant with salt. Use one to five pounds ferric sulfate and one pound of salt to every thousand gallons of solution. This will also coagulate lime. Remember that foreign substances in the lime can cause trouble. For this reason it is wise to analyze every batch of lime for CaO. $CaCO_3$, silica, etc. A record of the data will be helpful in determining the cause of tower plugging. It is possible that the caustic solution may contain harmful impurities and a similar record should be kept for each carload of caustic.

Keep in mind also that the process water used in the disposal plant comes from the creek and therefore may contain almost anything. In addition, it is treated with copper sulfate and Calgon (sodium acid phosphate) in Section 800.

Another cause for tower plugging is the oil mist content of the 216 gases. The mist is composed of 2144 from the Stokes vacuum pumps. The larger particles of mist are removed by the mist filters on the vacuum pumps but the smaller particles are untouched and flow to the disposal plant. These small mist particles can pass through the tower nozzle and eventually plug the tower. The possibility also exists that 616 may enter the disposal lines for one reason or another, and be carried into the tower. It will form a brownish orange precipitate on contact with the caustic solution and may be a source of plugging. The possibility also exists that hazardous amounts of enriched material may accumulate in the piping. Consequently, it is strongly urged that analyses for 616 and 25 be made at frequent intervals.

Some cases of tower plugging may be cleaned up by increasing the caustic feed rate. This may flush the tower. Worse cases will require elaborate treatment. The tower will have to be closed down and flushed with suitable solvents. Reverse flushing may be helpful. In extreme cases the tower may have to be repacked.

(c) Liquor Inlet Plugging

The tower feed distributors may plug, which can be observed by noting the tower feed pump discharge pressure, (if there is no plugging in the control valves, heat exchangers and piping). An increase in this pressure at constant flow will be due to inlet plugging. This is due to inadequate setting. See the remedies given above for tower plugging.

(d) Liquor Outlet Plugging

The tower outlet may become plugged. If the level controller

fails or if the outlet becomes completely plugged the caustic solution will back up in the tower and flow to the sewer through the drain tank shown in Figure II.1-6. Ordinarily the level controller will control the outlet pumping rate. If the level becomes too high or too low alarms will operate.

(e) Gas Inlet Plugging

Sodium fluorides may form in the nozzles and cause plugging. As shown in Figure II.1-6, 74 under 5 lbs gauge pressure may be used to clean the nozzles. Before the pressure is applied the 216 gas must be diverted to the emergency stack as explained above. If 5 lbs pressure is not sufficient, and higher pressure sources are not available, the tower will have to be shut down.

There is no automatic device to warn the operator in case the back pressure in the gas nozzles should increase. PBM's 331 and 333 transmit the nozzle pressures to recorders, giving the operator the only knowledge he has of nozzle conditions.

Gas inlet plugging may be due to two chief causes; formation of sodium fluoride in the nozzles and pipe plugging because of corrosion. It is recommended that 74 be continuously bled into the nozzles from the 74 connections. This will minimize back diffusion of moisture, which accelerates corrosion. Also, 100% sulfuric acid should be maintained in the seal traps AG-1 and AG-2, and the acid replaced when the concentration drops below 98%. Heaters have been provided on the piping between the seal traps and the tower, so that condensation of water, and consequent corrosion, is avoided.

(f) Effect of Process Gas in Gas Feed

For various reasons process gas may be encountered in the 216 gases entering the disposal plant. This will precipitate partially on contact with the caustic solution, and may cause plugging of pumps, lines and instruments. It may also result in the accumulation of hazardous amounts of enriched material. For these reasons, it is necessary to analyze the solution from the tower periodically for "T" and percent 25 as well as the solids in the settling tank. As long as measurable quantities of "T" are found in the tower effluent, it will be desirable to wash down the tower and piping (to the settling tank) at periodic intervals, to avoid excessive accumulation of solids in piping, valves, etc. Analytical methods for the analysis are those regularly employed by the Carbide and Carbon Chemicals Corp.

DISTRIBUTION

1. K-25 Site Records (RC)
2. ChemRisk/Shonka Research Associates
3. DOE Public Reading Room
4. S. G. Thornton (K-25 EMD)